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PAPERS ON INSECTS AFFECTING STORED PRODUCTS.

THE COWPEA WEEVIL.

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THE COWPEA WEEVIL.

(*Pachymerus chinensis* L.)

By F. H. CHITTENDEN, Sc. D.,
In Charge of Truck Crop and Stored Product Insect Investigations.

INTRODUCTION.

The seed of cowpeas are subject to the attack of several species of beetles, of which the cowpea weevil (*Pachymerus chinensis* L.) and the four-spotted bean weevil (*P. quadrimaculatus* Fab.) appear to be specific enemies, injuring the seed in much the same manner as does the common bean weevil. Like that species they begin operations in the field, and continue to breed for successive generations in the stored seed until they entirely spoil it for food and seriously impair its germinating power. Both species are generally distributed and injurious in the South, and are widening their range with the increasing use of their food plant as a soil renovator and as forage.

The cowpea weevil resembles the four-spotted bean weevil superficially in appearance, as in habit, but these two species differ to some extent in various details of their life economy, as well as in structure and distribution. They belong to the same genus of the family Lariidæ (Bruchidæ).

DESCRIPTIVE.

THE GENUS PACHYMERUS LATREILLE.

The genus Pachymerus, as defined by Allard, includes species having the following characteristics:

Posterior femora much thickened, armed on the underside near the extremity with small unequal teeth, and the tibiæ slender and curved.

The following is Schœnherr's definition:

Antennæ somewhat longer than the thorax, becoming wider toward the apex, compressed; joints subperfoliate, half as long as body, last six to eight joints acutely serrate. Head carinate. Eyes sublateral, deeply emarginate, prominent. Thorax in front strongly coarctate, slightly narrower than head; behind deeply

bisinuate; in the middle lobed, with acute angles. Elyta subquadrate, the apices separately rounded, above subplanose. Pygidium large, rounded at apex, descendant. Posterior femora strongly incrassate, slightly toothed and serrate about apex. Tibiæ terete [cylindrical], posterior tibiæ arcuate. Body short-ovate, more or less convex.

THE BEETLE.

The cowpea weevil may be readily distinguished from all other species of the family inhabiting the United States by the two large, elevated, ivory-like lobes at the base of the thorax and by the strongly pectinate antennæ of the male (see fig. 21, *a*). The body is more robust than that of other bean and cowpea feeding forms.

The ground color is dull red, sometimes more or less blackish, variegated with black, brown, yellow, and gray or white pubescence. The pattern of the elytra varies, that shown in the illustration being the prevailing form, the combination of colors making, with the somewhat feathery antennæ of the male, one of the most beautiful species of its family to be found in America north of Mexico. The darkest spots at the sides are not round and conspicuous as in the four-spotted bean weevil, and the apical spots are sometimes wanting, while often black is the prevailing color of the dorsal surface.

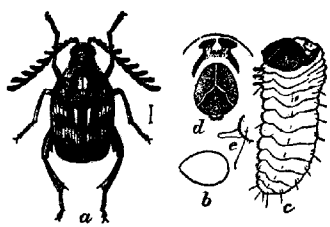


FIG. 21.—The cowpea weevil (*Pachymerus chinensis*): *a*, Adult male; *b*, egg; *c*, post-embryonic larva; *d*, front view of head of same; *e*, thoracic leg of same. *a*, Much enlarged; *b*, *c*, more enlarged. (Author's illustration.)

The following description, under the name *scutellaris* Fab., is from Horn's synopsis, published in 1873:[5*]

Short, robust, brownish, opaque. Hard brown, opaque, densely and coarsely punctured, front subcarinate. Antennæ variable, usually pale rufous, rarely with the outer joints nearly black, as long as head and thorax, male pectinate, female serrate. Thorax trapezoidal, sides nearly straight, base trisinuate, median lobe emarginate at middle; color brownish opaque; surface coarsely punctured intervals rugoso-granulate; median line in front and narrow space at sides sparsely clothed with cinereous pubescence, a small whitish spot on each side of the median line near the middle of the thorax, basal lobe white, ivory-like, clothed with whitish pubescence. Scutellum convex, white. Elytra sub-quadrate, feebly convex, wider at base than thorax; surface striate, striæ punctured, intervals flat, scabrous or finely punctulate; color usually brownish or ferruginous with darker spaces at base and humerus, and a darker space at middle of side connected along the margin. Pygidium nearly vertical, clothed with ochreous hairs, with a whitish line along the middle and a reniform brown spot on each side near the apex. Body beneath brownish, densely punctulate, sparsely clothed with whitish hairs; abdomen paler, with a band of white hairs at the sides. Legs, anterior and middle pairs, pale rufous.

* The small figures refer to the bibliography, pp. 93 and 94.

hind legs dark rufous or brownish. Hind femora armed near the tip with an acute tooth on the outer and inner side.

Length 2.5–3.5 mm.; width 1.5–1.8 mm. Smaller individuals, dwarfed, are frequently seen.

THE EGG.

The egg is ovate in outline, somewhat variable, but usually less than two-thirds as wide as long, rather broadly rounded anteriorly and more narrowly posteriorly, the extreme apex rounded, convex exteriorly and flattened interiorly. The attached surface is variable, but of considerable quantity, flattened upon the seed upon which it is deposited, a lateral view presenting the impression of an egg severed in half. When freshly laid it is clear, translucent. The surface is smooth, shining, with no visible sculpture.

Measurements of five eggs gave the following figures:

No. 1. Length 0.48 mm.; width 0.27 mm.
2. Length 0.49 mm.; width 0.32 mm.
3. Length 0.58 mm.; width 0.31 mm.
4. Length 0.51 mm.; width 0.33 mm.
5. Length 0.49 mm.; width 0.31 mm.

The above show a variation of from 0.48 to 0.58 mm. in length and from 0.27 to 0.33 mm. in width.

The empty eggshells on the seeds or pods in the course of time become opaque gray.

THE POSTEMBRYONIC LARVA.

The newly hatched larva (fig. 21, *c*) resembles somewhat that of the pea weevil. It is of course smaller, the minute temporary legs (see *e*) are apparently not jointed, and the prothoracic plate (*d*) bears blunt rounded teeth instead of acute spines.

SYNONYMY.

Pachymerus chinensis L.

Curculio chinensis Linn., Syst. Nat., 10th ed., p. 386. 1758.
Bruchus scutellaris Fab., Entom. Syst., vol. 1, Pt. II, p. 372, 1792.
Bruchus pectinicornis L., Syst. Nat., 12th ed., p. 665, pl. 16, fig. 7.
Bruchus adustus Motsch., Bul. Mosc., vol. 4, p. 228. 1873.
Bruchus rufus DeG., Mem., vol. 5, p. 281.

DISTRIBUTION.

This species is cosmopolitan in the widest sense of the word. Until comparatively recent years there appeared to be a belief prevalent among persons who have observed the cowpea-inhabiting weevils that the cowpea weevil was not so firmly established in the United States as the four-spotted form. It is not only thoroughly acclimated throughout the Gulf region, but appears to be found generally in temperate regions at least as far north as the District of Columbia, where it practically may be taken nearly every year in the field. In

the year 1896, when many cowpeas were grown in the District, it was very abundant in the field in September. Since that time it has not been so noticeable, probably because cowpeas are not so extensively grown here. It was the prevalent species in cowpeas in the Norfolk region in 1911. It is fairly certain that it is capable of establishing itself wherever its food plant will grow.

Described from China it was later identified in seeds from many localities and is now widely known through its distribution by commerce, being particularly abundant in tropical countries. Its recorded distribution abroad includes Europe; China, Japan, East India, and Korea, in Asia; Egypt, Sierra Leone, Barbary, Algeria, Rhodesia, Amani, and the Cape of Good Hope, in Africa; Porto Rico, Bermuda, Jamaica, British West Indies; Panama, Brazil, and Chile, in tropical America; Hawaii, Celebes, Java, Dutch East Indies, and Mauritius.

The cowpea is credited with having first been cultivated in this country in the early days of the eighteenth century, and the weevil came with it or soon afterwards, but there is no available record of the occurrence of the insect here earlier than 1853.[1]

LIFE HISTORY AND HABITS.

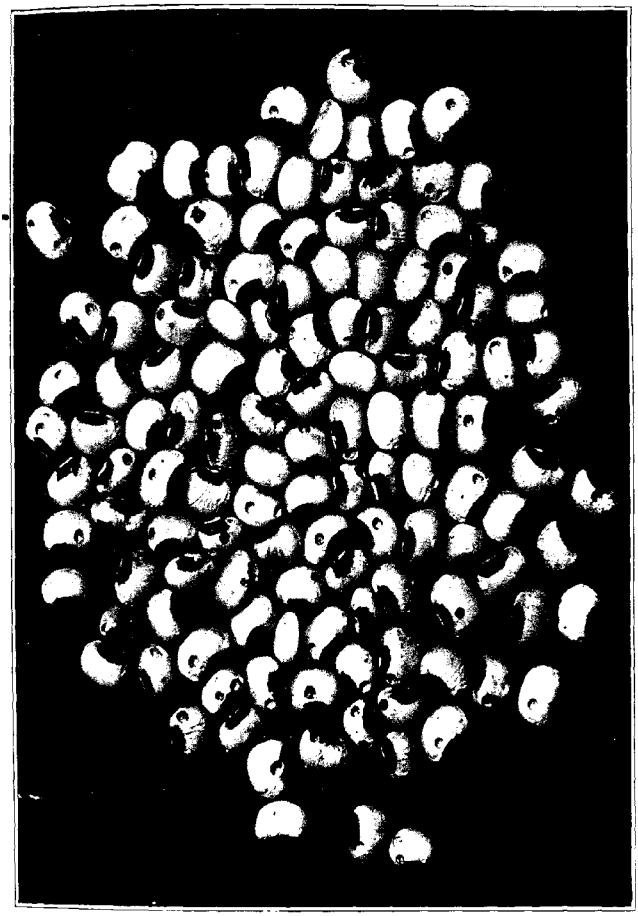
OVIPOSITION.

The usual process of oviposition on dry beans and similar seed as observed by the writer is as follows:

The female crawls about the seed to select a place for deposition; after a few seconds she stops and remains perfectly quiet and in less than a minute, sometimes at once, begins to extrude the egg, completing the operation by a curious and vigorous wriggle from side to side and a short forward motion as the egg is deposited. Within less than another minute, sometimes at once, she turns about and examines the egg with her palpi. Sometimes this is omitted and she rests for a time; again she proceeds at once to repeat the operation in from three to four minutes after the first egg was laid, always crawling about for half a minute or more to select a new place for its reception.

Apparently it is the general rule with this, as well as with related species and with many other beetles, to deposit each egg on a different seed, but sometimes two, three, or even four are deposited on the same seed by the same female, and other females follow until an indefinite number are deposited on one seed. As many as 30 eggs may be counted, in badly infested material, on a single seed of cowpea measuring three-eighths of an inch in length. Plate I shows the eggs of this species on Blackeye cowpeas.

[1] F. E. Melsheimer, Cat. Col. U. S., 1853, p. 99, mentioned as *scutellaris* Fab., synonym of *sinuatus* Schoen.



BLACKEYE COWPEAS INFESTED BY THE COWPEA WEEVIL (PACHYMERUS CHINENSIS), SHOWING EGGS AND EXIT HOLES. (ORIGINAL.)

In a heated period the beetles may be so active as to gnaw their way out from the holes in the seed within 24 hours. The males seek the other sex almost as soon as they emerge from the seed and copulation and egg laying begin very soon thereafter. Copulation has been witnessed within at most four hours after issuance, and eggs have been found the same day.

LIFE-CYCLE PERIODS.

This species was kept breeding throughout the winter in a warm room with an average temperature of about 70° F. During March and April experiments on the life cycle were begun. A number of adult weevils were confined in a rearing jar with fresh beans April 27, and removed after 24 hours, numbers of eggs having been laid during that period. From this lot larvæ began to emerge from the eggs May 5, showing a period of incubation of 8 days or about the same as for (*Bruchus*) *Acanthoscelides obtectus* in about the same temperature, which has been ascertained to be between 8 and 10 days.

A larva, about to transform to pupa on April 9, pupated on April 10, and appeared as imago April 20, or in 10 days, in similar cool weather in April. Five larvæ were removed from their cocoons in the beans and assumed the pupal state April 20, from which two issued as imago April 27, or in 7 days in slightly warmer weather. The remainder failed to transform, and it was noticed that about 25 per cent of the larv, removed from their cocoons when about to transform to pupæ, perished before assuming the adult condition, showing the necessity of the protection of the cocoon within the seed.

A pair of weevils was confined in a rearing jar May 23, with chickpeas, and from this lot the next generation was obtained June 24, or in 32 days.

In another lot of chickpeas, which were still drier than the last, the imago did not develop until 38 days, showing that this species naturally develops in fresh seed more rapidly than in dry seed. In garden peas, beetles developed in 30 days, from June 7 to July 7, in still warmer weather. In other lots kept under different conditions in a cooler room, the entire life cycle in March and April was 45 and 60 days in two experiments.

Another experiment was made in a hot room during the latter part of June and in July and the entire life cycle was passed in 21 days, from egg to adult, showing with the next experiment that in the warmest season of the year in a climate like that of the District of Columbia, where the temperature not infrequently reaches from 90° to 100° F. for prolonged periods, this insect may pass through its transformations in an astonishingly short time.

Finally a lot of fresh beans was placed in a rearing jar containing beetles June 23, and in a few days the beans were removed covered

with eggs. The beetles were also removed. On July 12 two males emerged from this lot and the first bean opened disclosed a newly hatched beetle. Allowing at least a day for the beetle to mature sufficiently to gnaw through the outer shell of the bean, we have in this case the completed life cycle in 18 days.

NUMBER OF GENERATIONS.

It will be readily seen that with a species capable of developing in from three to eight weeks according to temperature, we have a possibility in a heated atmosphere of six, seven, or even eight generations annually. Knowing the effect of temperature on the development of insects in general, and of a rapidly breeding species like the present in particular, we may say approximately that throughout the coldest months in the District of Columbia, January and February, in storage in a heated temperature of about 70° F., it is possible for one generation to develop; in the higher temperatures indoors during March, April, and May, two generations; in the still higher temperatures of June, July, and August, one generation in each month; in September and October, one generation; and between the latter part of October and the last of December another generation, making a theoretically possible annual total of eight generations. There is apt to be a resting stage, however, at some point, as was observed on one occasion. During the second week of April, in a heavily infested lot of seeds where the beetles were emerging in large numbers, literally by hundreds almost every day, development suddenly ceased and the beetles did not again appear until about a week later. Two days afterwards they had again become abundant. In cool temperatures the number of generations will be less—three, four, or five—while in colder temperatures the species will probably not survive.

Some other records, the details of which have not been preserved, are available showing that the egg period in the high temperature of midsummer weather may be four or five days and the pupal stage a similar period. A summary of the different periods is shown in the following table. The larval periods are necessarily estimated by subtracting the period of incubation and that of the pupa from the total life cycle. The other periods which are indicated in the table by a star (*) have been estimated in a similar manner; the remaining periods have come under actual observation.

Developmental periods and life cycle of the cowpea weevil.

	March-May.	June-July.	Minimum.	Maximum.
			° F.	° F.
Egg	8, 10	3*, 4, 5, 6*	3*, 4	10
Larva	17, 25, 40	12, 13, 18	12, 13	40
Pupa	7, 10	3*, 4, 5, 6*	3*, 4	10
Cycle	32, 45, 60	18, 21, 30	18	60

LONGEVITY OF ADULTS.

The beetles of this species have not been noticed feeding. Possibly hey feed on the nectar of flowers in the open, but this is not essential o their existence. In experiments to determine the duration of life ndoors considerable variation was encountered. May 16, 20 adults ecently developed were separated and placed on dried beans. All vere dead on May 28, with one exception—a male, which lived until June 21—showing the longevity of 19 individuals to be 12 days and 'or this one 36 days. Similar experiments were made under perhaps ›etter conditions and some beetles were still living at the end of .7, 18, 19, and, in one case, 25 days.

FOOD PLANTS.

This species is seemingly capable of breeding on most forms of ›dible legumes, infesting practically all of the cowpeas and beans, ınd their numerous varieties, "Adsuki" beans (*Phaseolus radiatus*), ›igeon peas (*Cajanus indica*), garden and field peas, lentils, chick-›eas (*Cicer arietinum*), and the Ceylonese seeds known as "gram" ›r "mung," and in their native home as "kolu" and "muneta," *Phaseolus mungo*.

We have reared it from *Vigna catjang* and *V. unguiculatus* of many varieties, *V. sinensis*, and *Dolichos biflorus*, and the species has been ›ollected in fields of broad beans. In the case of its attacking lentils, he beetles have, on several occasions, been found in India and in the lry seeds in the District of Columbia. It is not probable that the ›pecies can develop in the smallest sized seeds, unless it infests them ın the same manner as the lentil weevil does in the field by traveling from one seed to another in the pod. Glycine, a small green variety of soy bean from China, from which we have reared it, appears to be ın unrecorded food plant. Of other food plants, Lefroy and How-lett[22] have recorded *Dolichos lablab*, the hyacinth bean.

THE POINT OF EXIT OF THE BEETLE FROM THE SEED.

While examining some Blackeye cowpeas for illustration it was noticed that the majority of the seed showed exit holes of the beetle on the anterior or left half of the seed viewed with the plumule or germ end downward. To learn how general this was, 100 seed were counted out, with the result that 47, or nearly 50 per cent, showed exit holes on the anterior half, 29 on the posterior or right half, 8 near the middle, and 5 near one end, while 11 showed two exit holes. These seed were from the field at Norfolk, Va., where only moderate infestation occurred. In no case was the plumule or germ invaded, the beetles not even attacking the "eye" or black

area surrounding the germ. Whether this location of the exit hole, which shows the point at which the larva developed, is constant or not, or whether it is due to the manner of growing, or exposure to direct sunlight, or to shade, remains to be learned. It is not an economic proposition, but is a matter of some interest scientifically.

Another lot of cowpeas infested by the four-spotted bean weevil was examined for comparison and gave similar results. Estimated by percentages of exit holes, on the left side there were 48 per cent, on the right side 26 per cent, near the center 8 per cent, and at one end 6 per cent, while 12 per cent contained two exit holes. It is easy to separate the work of the two species in spite of this fact, however, because of the larger and somewhat more irregular exit holes made by the beetle of the four-spotted species.

SUSCEPTIBILITY OF DIFFERENT VARIETIES OF COWPEA.

From observation of the seed of cowpea grown upon the experimental plats of the department grounds and obtained from other sources it appears that certain varieties are preferred to others by the cowpea weevil as well as by weevils of related habits. When the insect is extremely abundant it is not apt to discriminate between varieties; or, in other words, if the favorite plant is not present in the vicinity where the insect happens to abound, it will not hesitate to attack whatever variety may be ready at hand. There is the best of evidence for the belief that these weevils, like the grain weevils (Calandra), prefer the softest seed because more easily penetrated, and that they experience more or less difficulty in entering harder seed.

The favored variety here, and apparently elsewhere, judging mainly from seed taken direct from the field, appears to be the Blackeye, although all the varieties grown were attacked, the Lee variety less so than any of the others. The different varieties observed are listed in approximate order of infestation as follows: Blackeye, Browneye, Black, Lady, Rice, Manakin, Southdown, Red Ripper, Whippoorwill, New Era, Red Crowder, Unknown, and Lee.

SUMMARY OF LIFE HISTORY.

The cowpea weevil does not differ very strikingly in its life habits and economy from the common bean weevil. A careful study of the biology of each, however, has been rewarded by the development of certain points of difference, which may be briefly summarized.

The eggs are deposited on the outside of the growing pods in the field and upon the dried seeds, and are attached by a glutinous substance which covers the egg and extends somewhat around it. The larvæ hatch from them in four, five, or more days, depending

pon the season, temperature, and other circumstances, and burrow ıto the pods to the developing seed, which they penetrate. In ıvo or three weeks in midsummer weather, and in about two months ı cooler weather, they attain full growth, when they present much ıe same appearance as the larvæ of other bean and pea weevils. 'he pupal state lasts from about four or five days in warm weather) considerably longer in cooler weather, whereupon the beetle form ; assumed. The beetle gnaws its way out of the seed in the same ıanner as do the related species, by cutting a round flap through the ;in of the pod. The first brood which develops in the field attains ıaturity by about the third week of September, or perhaps earlier, f we may judge by the appearance of the exit holes in the pods nd the further fact that certain varieties of cowpea mature sooner han this.

The beetles continue to develop in the stored seed for several ;enerations, in fact until the seed becomes completely ruined for ny practical purpose and unfit even for the sustenance of this nsect; then decomposition sets in, inviting swarms of mites, and he beetles are forced to other quarters in their struggle for existence.

In a fairly warm indoor temperature six or seven broods probably levelop annually in a latitude like that of Washington, D. C.

LITERATURE.

In 1758,[1] Linnæus described this species, giving it its specific name 'rom its known habitat at that time. On this head he wrote "*Habitat n Pisis omnis generis, e China allatis*," showing that its injurious ıabit was known even at that early date, and that China was evi-lently the original home of this species.

It will not be necessary to mention all of the references cited in he bibliography which will follow.

In 1890 Dr. J. A. Lintner[9] published the first general account of his species. His published life history was a surmise, and later proved to be incorrect by his own statement. In 1896 Messrs. Osborn and Mally[16] gave a more extended account of this species, based on its occurrence in Iowa, with notes on its life history, effects of fumi-gation with carbon bisulphid, and results of germination tests to de-termine the effect of bisulphid of carbon on the fumigated seed. The difference in comparison with a check lot showed practically no in-jury by this form of treatment, the final conclusion being reached that "the germinating power of the seeds was not impaired." Three new food plants were mentioned—green field peas, horse beans, and soy beans. Unfortunately this species was confused with the related four-spotted bean weevil, both being present in the seeds under ob-servation. The following year, 1897, the writer[17] brought together a summarized account of this species based largely on personal inves-

tigations, and the year afterwards [18] gave a more general economic account, together with figures and brief descriptions of the egg and postembryonic larva. In 1909 Lefroy and Howlett [21] recorded three new food plants.

It is interesting to note that it has been noticed of this weevil that material infested by it undergoes marked elevation in temperature, particularly at times when the beetles are undergoing transformation and issuing from the seed. In one instance, the temperature of a small sack of seed infested by the cowpea weevil was found to be 25° F. higher than the surrounding atmosphere.

METHODS OF CONTROL.

General remedies.—The remedies to be employed for the cowpea weevil are practically the same as for the bean weevil and the four-spotted bean weevil, both of which have the same habit of breeding continuously in stored seed. Remedies are fully discussed under "Methods of control" in a previous article on the broad-bean weevil.[a] Bisulphid of carbon and hydrocyanic-acid gas fumigation are the best. The hot water remedy, dry heat, and the introduction of parasites from localities where these are established, into others where they are not known to occur, are all desirable. It should be added that it is impossible to prevent injury in the field or to stamp this species out, since it is already too well established from Maryland southward and westward.

Holding over the seed, as practiced for the pea and broad-bean weevils, is a useless remedy for this species.

Full directions for the application of dry heat and of hot water, and for fumigation with bisulphid of carbon, are given in the article on the broad-bean weevil and instructions for fumigation with hydrocyanic-acid gas are furnished in Circular 112 of the Bureau of Entomology.

Drying the seed.—Frequent inquiry is made in regard to the control of weevils in cowpeas by what is known as "kiln drying," a method which is stated by correspondents in the South to be used in California. Inquiry of several agents of this bureau who have been engaged in work in California fails to elicit the fact that the kiln-drying process is used in that State; indeed, we have no specific knowledge of the use of this practice in any locality. There is, however, a process which is sometimes so termed. It consists of passing cowpeas, grain, and other seeds and foodstuffs over heated pipes, or passing heated air through them in such a manner as to subject the infested material to a temperature of 135° to 140° F., which is fatal to the larvæ and adults of the cowpea and other weevils, as it is also to their eggs. This process is at present used mainly for grain, espe-

[a] Bul. 96, Pt. V, Bur. Ent., U. S. Dept. Agr., pp. 75–80, 1912.

ially for corn stored in elevator tanks, and has proved to be quite fficient. While we have advised this remedy for some time, we have had no opportunity to test it personally and none of our correspondents has written in regard to its value. There is no reason, however, for supposing that it should not prove effective to all insects in cowpeas or other leguminous seed as well as to those in other stored products. This process is simplified by the use of a machine called a "dryer." Several forms of this instrument are in use. They are manufactured by firms in Massachusetts, Chicago, Ill., and New York State.

BIBLIOGRAPHY.

1. LINNÆUS, CAROLUS.—Systema Naturæ, 10th ed., p. 386, 1758.

   Original description as *Curculio chinensis*.

2. FABRICIUS, J. C.—Entomologia Systematica, vol. 1, pars 2, p. 372, 1792.

   Description as *Bruchus scutellaris*, without locality.

3. KIRBY and SPENCE.—Introduction to Entomology, vol. 1, 1815; 4th ed., 1822, p. 177.

   Mention both as *B. pectinicornis* devouring "peas in China and Barbary" and as *B. scutellaris* (?) in "grain" or "koloo" in India.

4. ALLIBERT, ALPH.—Revue Zoologique, ser. 1, vol. 10, p. 13, January, 1847.

   In beans from Brazil.

5. HORN, G. H.—Transactions American Entomological Society, vol. 4, p. 317, 1873.

   Technical description.

6. HEYDEN, L. v.—Deutsche Ent. Zeitschrift, vol. 23, pp. 357, 358, 1879.

   Notes on food habits, distribution, etc.

7. BAUDI, F.—Deutsche Ent. Zeitschrift, vol. 31, part 1, p. 33, 1887.

   Technical descriptive account of 1 page.

8. HOWARD, L. O.—Insect Life, vol. 1, pp. 59, 60, August, 1888.

   A note on the heat evolved in cowpeas infested by this insect.

9. LINTNER, J. A.—Sixth Report of the State Entomologist of New York, pp. 127–129, 1890.

   Description, literature, probable life history, and remedies.

10. HOWARD, L. O.—Insect Life, vol. 4, p. 49, October 28, 1891.

    Mere mention of parasite reared by Dr. Doran; doubtfully referred to Bruchophagus.

11. EDITORIAL.—Insect Life, vol. 4, pp. 160, 161, December 2, 1891.

    Temperature of weevil-infested peas.

12. EDITORIAL.—Insect Life, vol. 5, p. 165, January, 1893.

    Listed as "bred from beans at New Orleans Exposition"; "infesting Chinese beans in the Seed Division, U. S. Department of Agriculture."

13. COTES, E. C.—Indian Museum Notes, vol. 2, p. 152, 1893; vol. 3, pp. 25, 129, fig.

    "Very destructive to stored pulses (*Cajanus indica*, etc.)"; "Common grain weevil; often very troublesome;" figured.

14. RILEY, C. V.—Insect Life, vol. 6, pp. 220, 223, February, 1894.

Listed from beans and other edible legumes from Japan, Porto Rico, and Ceylon, exhibited at World's Fair in 1893.

15. QUAINTANCE, A. L.—Bulletin 36, Florida Agricultural Experiment Station, p. 370, 1896.

A brief account; injury to cowpea.

16. OSBORN, H., and MALLY, C. W.—Bulletin 32, Iowa Agricultural Experiment Station, pp. 386–394, figs. 2, 3, 4, 1896.

Appearance in Ames, Iowa; life history notes; description; fumigation with carbon bisulphid; germination tests. Mention as *Bruchus quadrimaculatus*, but *chinensis* figured.

17. CHITTENDEN, F. H.—Bulletin 8, new series, Division of Entomology, U. S. Department of Agriculture, pp. 24–27, fig. ♂, 1897.

Summarized account; review of economic literature, comparative description, damage, food plants, distribution, development in brief, and natural enemies.

18. CHITTENDEN, F. H.—Insects injurious to beans and cowpeas. < Yearbook U. S. Department of Agriculture, 1898 (1899), pp. 242–245, fig. 71, 1898, separate.

Two and one-half page popular economic account with brief descriptions and figure of egg, postembryonic larva, and adult.

19. SCHILSKY, J.—Kafer Europas, vol. 41, p. 99, 1905.

Description, bibliography, and assignment to genus Pachymerus.

20. LEFROY, H. M.—Indian Insect Pests, pp. 254, 255, fig. 311, 1906.

Common in pulse in India.

21. LEFROY, H. M., and HOWLETT, F. M.—Indian Insect Life, p. 350, fig. 223, 1909.

Recorded in India in *Pisum sativum, Dolichos lablab, Dolichos biflorus, Cicer arietinum, Cajanus indica, Ervum lens,* and *Vigna catjang.* Figure of eggs on pea, larva?, and adult.

22. DAWSON, R. W.—Annual Report of the Nebraska State Board of Agriculture for 1909, pp. 249 and 250, 1910.

Short economic account.

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